higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NASIENRIGLYN

NASIONALE SERTIFIKAAT

ELEKTROTEGNIEK N4

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Hierdie nasienriglyn bestaan uit 9 bladsye.

Kopiereg voorbehou

VRAAG 1

1.1 struktuur
1.2 magnetomotoriese
1.3 antikloksgewys
1.4 kortomtak
1.5 alternator
1.6 WS
1.7 reluktansie
1.8 sleepringmotor
1.9 kragsentrales
1.10 vermenigvuldigers

(10 × 1) **[10]**

VRAAG 2

2.1 $P = I^2R$

$100 = (0,5)^2 xR$ ✓

$R = 400\Omega$

$V_p = IR = (0,5)(400) = 200V$ ✓

$V_x = 250 - 200 = 50V$ ✓

$I_1 = \frac{V_P}{1000} = \frac{200}{1000} = 0,2A$ ✓

$I_T = 0,5 + 0,2 = 0,7A$ ✓

$V_x = I_x xR_x = I_T R_x$

$50 = 0,7R_x$ ✓

$R_x = 71,428\Omega$

OF

$R_P = \frac{(400x1000)}{(400+1000)} = 285,714\Omega$ ✓✓

$V_T = I_T R_T$

$250 = 0,7R_T$ ✓✓

$R_T = 357,143\Omega$

$R_T = R_P + R_x$

$R_x = R_T - R_P = 357 - 285 = 71,428\Omega$ ✓✓

(6)

2.2 $A = ?$
$L = 74m$
$I = 16A$
$V_D = 6,4V$
$\rho_{cu} = 0,017\mu\Omega m$

$V = IR$
$6,4 = 16R$ ✓✓
$R = 0,4\Omega$

$R = \rho\frac{L}{A}$
$0,4 = \frac{(0,017x10^{-6}x74)}{A}$ ✓✓
$A = 3,145x10^{-6}m^2 = 3,145mm^2$ (4)

2.3 $R_1 = 128\Omega$ $R_2 = 136\Omega$
$t_1 = 22°C$ $t_1 = ?$
$\alpha_0 = 0,004$ $\alpha_0 = 0,004$

$\frac{R_1}{R_2} = \frac{R_0(1+\alpha_0 t_1)}{R_0(1+\alpha_0 t_2)}$
$\frac{128}{136} = \frac{1+(0,004)(22)}{1+(0,004)(t_2)}$ ✓✓
$\frac{128}{136} = \frac{1,088}{1+0,004(t_2)}$ ✓
$t_2 = 39^0C$ ✓ (4)

2.4 $C_1 = 5\mu F$
$C_2 = 8\mu F$
$V = 90V$

$C_T = \frac{C_1xC_2}{C_1+C_2} = \frac{5x8}{5+8} = 3,0769\mu F$ ✓

$Q_T = V_TC_T = 90x3,0769 = 276,92\mu C$ ✓
$Q_T = Q_1 = Q_2 = 276,92\mu C$

$Q = VC$
$V_1 = \frac{Q_1}{C_1} = \frac{276,92}{5} = 55,385V$ ✓
$V_2 = \frac{Q_2}{C_2} = \frac{276,92}{8} = 34,615V$ ✓ (4)
[18]

VRAAG 3

3.1
- Battery
- Generator
- Sonenergie
- Termokoppel
- Wrywing of statiese elektrisiteit (Enige 2 x 1) (2)

3.2 3.2.1 Suiwer metale – Weerstand sal toeneem

3.2.2 Koolstof – Weerstand sal afneem

(2 × 1) (2)

3.3 L = 15 m
V = 12 m/s
B = 0,7 T (Wb/m²)
I = 0,5 A

E = BLV = (0,7)(15)(12) = 126 V✓

F = BIL = (0,7)(0,5)(15) = 5,25 N✓

P = IV = IE
= 0,5 × 126✓✓
= 63 W (4)

3.4 In lus ABEFA:

$$\sum E = \sum IR$$
$$28 - 20 = 0,5I_1 + 0,2(I_1 + I_2) \quad ✓✓$$
$$8 = 0,7I_1 + 0,2I_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

In lus ACDFA:

$$\sum E = \sum IR$$
$$28 - 16 = 0,7I_2 + 0,2(I_1 + I_2) \quad ✓✓$$
$$12 = 0,2I_1 + 0,9I_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

(2) x 3,5:

$$42 = 0,7I_1 + 3,15I_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$ ✓✓

(3) – (1):

$$34 = 2,95I_2$$
$$I_2 = 34 / 2,95 = 11,525A$$ ✓✓

Vervang I_2 in (1):

$$8 = 0,7I_1 + 0,2(11,525)$$ ✓✓
$$I_1 = 8,136A$$

(10)
[18]

VRAAG 4

4.1

- Die ysterkern van die poolstukke kon hul magnetismeres verloor het. In hierdie geval moet die magnetismeres herstel word deur 'n gelykstroom in die korrekte rigting deur die veldwikkelings te stuur. (2)

- As die veldspoele verkeerd gekoppel is, sal die stroom wat deur die magnetismeres geïnduseer is in die teenoorgestelde rigting deur die veldspoele vloei. Dit sal tot gevolg hê dat die veldsterkte van die poolkerns afneem in plaas daarvan om toe te neem, en die generator sal nie opwek nie. Om die fout reg te stel moet die konneksie van die veldwikkelings omgekeer word. (3)

- Ander toestande wat kan verhoed dat 'n generator opwek, sluit die volgende in:
  - borsels wat in hul houers belemmer word
  - vuil borsels of kommutator/stroomwender
  - 'n oop of gekortsluite veldstroom
  - los borselverbindings
  - 'n ankerspoed wat te laag is
  - 'n veldstroomweerstand wat te hoog is (3) (8)

4.2 $R_x = ?$

$V = 440V$

$P = 10kW$

$R_a = 0,67\Omega$

$R_f = 161\Omega$

$$I_L = \frac{P}{V} = \frac{1000}{440} = 22,7A \checkmark$$

$$I_f = \frac{V}{R_f} = \frac{440}{161} = 2,7A \checkmark$$

$$I_a = I_L - I_f = 22,7 - 2,7 = 20A \checkmark$$

$$I_{start} = 1,5I_a = (1,5)(20) = 30A \checkmark$$

E = 0 vir aansitting (stilstaan):

$$V = E + I_a(R_a + R_x)$$

$$440 = 0 + 30(0,67 + R_x)$$

$$R_x = 13,99\Omega \checkmark\checkmark\checkmark$$ (7)

4.3 $Z = 540$

$p = 2(4\,poles)$

$c = 2p = (2)(2) = 4$

$\phi = 0,025Wb$

$E = 406V$

$$E = \frac{2\phi ZpN}{60c}$$

$$406 = \frac{(2)(0,025)(540)(2)N}{(60)(4)}$$ ✓✓✓

$N = 1804r/m$ (3)

[18]

VRAAG 5

5.1 $f = 50Hz$

$E_m = 311$

$t = ?$

$e = 180v$

$$e = E_m \sin 2\pi ft(\frac{180}{\pi})$$

$$180 = 311\sin 2\pi(50)t(\frac{180}{\pi})$$ ✓

$$\sin^{-1}(\frac{180}{311}) = 2\pi(50)t$$ ✓

$t = 0,00196\sec = 1,96m\sec$ ✓ (3)

5.2 $$e_1 = 75\sin(wt + \frac{\pi}{6})$$

$= 75\sin(wt + 30°) = 75\angle 30°$

$= 64,952 + j37,5$ ✓✓

$$e_2 = 98\sin(wt - \frac{\pi}{4})$$

$= 98\sin(wt - 45°) = 98\angle -45°$

$= 69,296 - j69,296$ ✓✓

$e_T = e_1 + e_2$

$= 134,248 - j31,796 = 137,962\angle -13,324°$

$= 13,962\sin(wt - 13,324°)$ ✓

$E_{rms} = 0,707E_m$

$= 0,707(137,962) = 97,539V$ ✓ (6)

5.3 $R = 5\Omega$ $I_T = ?$
$L = 0,011H$ $V = 225V$
$C = 198\mu F$ $f = 50Hz$

$X_L = 2\pi fL = 2\pi(50)(0,011) = 3,456\Omega$ ✓
$X_C = \frac{1}{2\pi fC} = \frac{10^6}{2\pi(50)(198)} = 16,076\Omega$ ✓

$Z_1 = 5 + j3,456 = 6,078\angle 34,65°$ ✓

$Z_2 = 0 - j16,076 = 16,076\angle -90°$ ✓

$I_1 = \frac{V}{Z_1} = \frac{225\angle 0°}{6,076\angle 34,65°} = 37\angle -34,6° = 30,47 - j21$ ✓

$I_2 = \frac{V}{Z_2} = \frac{225\angle 0°}{16,076\angle -90°} = 13,996\angle 90° = 0 - j13,996$ ✓

$I_T = I_1 + I_2 = 30,472 - j7,025 = 31,271\angle -13°$ ✓

Dus:
Toevoerstroom = 31,271 A✓
Verplasingshoek = 13°✓ (9)
[18]

VRAAG 6

6.1 6.1.1 $\frac{N_1}{N_2} = \frac{V_1}{V_2}$ ✓
$\frac{142}{N_2} = \frac{250}{60}$
$N_2 = 34,08 = 34 turns$ ✓ (2)

6.1.2 $E_1 = 4,44\phi_m f N_1$
$250 = 4,44\phi_m(50)(142)$ ✓✓
$\phi_m = 0,00793$

$\phi_m = BA$
$0,00793 = B(0,04)$ ✓✓
$B = 0,198T(Wb/m^2)$ (4)

6.1.3 $I_2 = ?$
$P = 5kW$
$Cos\phi = 0,8$

$P = V_2 I_2 Cos\phi$
$5000 = (60) I_2 (0,8)$ ✓✓
$I_2 = 104,167A$ (2)

6.2 $R_m = 75\Omega$
$I_m = 300mA = 0,3A$

$V_m = I_m R_m = 0,3x75 = 22,5v$ ✓
$V_T = V_m + V_{se}$
$60 = 22,5 + V_{se}$ ✓
$V_{se} = 37,5V$

$R_{se} = \frac{V_{se}}{I_{se}} = \frac{V_{se}}{I_m} = \frac{37,5}{0,3} = 125\Omega$ ✓✓ (4)

6.3
- Dit is goedkoper.
- Beheerkringe is meer betroubaar.
- Toevoer (WS) is altyd beskikbaar.
- WS-motors is kleiner en ligter.
- Instandhouding is minder as vir GS-motors. (Enige 3 x 1) (3)

6.4
- Bronne – Om naby hul voorsieningsbronne te wees, byvoorbeeld myne.
- Besoedeling – Om nie die gemeenskappe naby hierdie sentrales te beïnvloed nie.
- Gevaar – Om enige gevare met betrekking tot mense en lewende hawe/vee te vermy. (Enige toepaslike 3 x 1) (3)

[18]

TOTAAL: 100

Kopiereg voorbehou